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SYSTEM CONCEPTS FOR THE OPERATIONAL MEDICAL INFORMATION SYSTEM (OMIS): A SYMPOSIUM

Design Concepts of the Operational Medical Information System (OMIS)—W. M. Pugh
Report No. 84-40

The Fleet Marine Force Combat Casualty Medical Information System: An Overview—
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Preliminary Specifications for a Shipboard Medical Information System—J. C. Helmkamp
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The Operational Medical Information System (OMIS) in Navy Branch Clinics—
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Selection of a Field Severity Scoring System for the Navy Operational Information System:
—F. C. Garland
Report No. 84-44

NAVAL HEALTH RESEARCH CENTER
P.O. BOX 85122
SAN DIEGO, CALIFORNIA 92138-9174

NAVAL MEDICAL RESEARCH AND DEVELOPMENT COMMAND
BETHESDA, MARYLAND

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SYSTEM CONCEPTS FOR THE OPERATIONAL MEDICAL INFORMATION SYSTEM (OMIS):

A SYMPOSIUM

Environmental Medicine Department

Naval Health Research Center

P. O. Box 85122

San Diego, CA 92138-9174

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System Concepts for the Operational Medical Information System (OMIS):

A Symposium

Preface

Significant research and development is being directed towards improving medical information management capabilities for the U.S. Navy. This work was described in a series of papers presented at the Eighteenth Annual Hawaii International Conference on System Science, in Honolulu, Hawaii, on 2-4 January 1985. These papers are assembled here under one cover to provide an integrated overview of system concepts for naval operational environments.

William Pugh in "Design Concepts of the Operational Medical Information System (OMIS)" describes how OMIS is designed to provide an automated system for the U.S. Navy and Fleet Marine Force. The three subsystems planned within OMIS involve the remote shore clinics, shipboard medical department, and the Fleet Marine Force.

"The Fleet Marine Force Combat Casualty Medical Information System: an Overview", by LCDR M.W. Congleton details the field component of the Fleet Marine Force subsystem of OMIS. Specific information needs for each echelon of care are detailed and hardware/software requirements are outlined.

Concepts for the development of the Shipboard Medical Information System are described by LCDR J.C. Helmkamp in "Preliminary Specifications for a Shipboard Medical Information System." The shipboard system must be 'hardened' in order to survive harsh environments encountered during various operational conditions. It must produce reliable medical information on members' health status and provide for the rapid cross-referencing and data retrieval necessary in a medical surveillance system.

In "The Operational Medical Information System (OMIS) in Navy Branch Clinics", CDR F.D. Glogower, et. al., explains how a systems analysis approach is being undertaken for Navy Branch Clinics in order to develop a system design. Existing medical information systems will be used to offer guidelines for further development of this subsystem of OMIS.

Injury severity scoring techniques are reviewed by F.C. Garland in "Selection of a Field Severity Scoring System for the Navy Operational Medical Information System." The possible use of injury severity scores to aid in case management and evaluation of medical care effectiveness is examined. *Keywords: Computer Program, Hardware, Structure Information, Survivability requirements.

DESIGN CONCEPTS OF THE OPERATIONAL MEDICAL INFORMATION SYSTEM (OMIS)

William M. Pugh

Abstract

The Operational Medical Information System (OMIS) is a program for developing an automated system for routine and casualty care. To accommodate the range of operational environments OMIS must include, three subsystems are planned. These subsystems correspond to the three primary types of operational medical facilities, the Fleet Marine Force medical company, the shipboard medical department, and remote shore clinics. The interoperability required among these subsystems is accomplished by maintaining a single library of software tools and developing the separate subsystems using these tools, by using a common data dictionary, and by using a standard medium for data transfer. To develop such a system quickly and efficiently MUMPS has been selected as the software environment for OMIS.

INTRODUCTION

Fleet medical readiness is maintained by the Navy Medical Command through services provided by the Fleet Hospitals and various satellite facilities located in operational environments near the personnel served. These operational medical facilities, which include branch clinics, shipboard medical departments, and the medical companies attached to the Fleet Marine Force (FMF) provide routine preventative medical treatment and hold sick call to insure maximum readiness of combat personnel. In the event of armed conflicts, these operational medical facilities provide the casualty care critical for achieving patient stabilization. The Operational Medical Information System (OMIS) is being developed to meet the information processing requirements of these operational medical facilities.

In operational environments there is generally a limited number of physicians or no medical doctors at all. For example, only the largest Navy ships have physicians aboard. Most shipboard medical deparetments are managed by an independent duty corpsman. Therefore, automation is needed to alleviate administrative burdens from the limited number of medical personnel available and provide a computerized assist when possible. In response to these needs the Navy Medical Research and Development Command has sponsored several programs designed to streamline medical reporting by automating the patient record, to provide systems for computer-aided diagnosis, and to develop methods for rapid assessment of trauma severity and organ functioning[1-5].

As the feasibility of various methods and techniques is established, one is faced with the problem of implementation. Although it is not difficult to field any single function, the array of different systems being developed and the variety of approaches for deploying them makes it clear that a general information system must be developed to serve as the vehicle for their implementation. In this regard the feasibility of a medical information system for combat

casualty care has been investigated for meeting the needs of the FMF[6]. Also, the development of a medical information system for Navy ships has been considered and automated processing of medical information is currently identified as one of the functions to be integrated into another system under development--the Shipboard Non-tactical Automated Data Processing (SNAP) program. However, no progress has been made in developing the medical component of SNAP. Finally, it should be noted that the U.S. Army is developing the Theater Army Medical Management Information System (TAMMIS) to provide medical support functions such as blood management and medical regulating.

DESIGN OBJECTIVES

The concept of the Operational Medical Information System (OMIS) was originated because the existing schemes did not fully support personnel in operational environments. To provide full support for these personnel the system should directly benefit the individual patient. Further, the system should support casualty care as well as routine care. Therefore, to provide full support, a system must first automate the patient record. Although TAMMIS provides valuable logistical support and certainly provides an indirect benefit to personnel in combat by improving the management of medical resources, the lack of a patient record prevents the system from addressing any particular individual. The proposed systems for Navy ships and for the FMF are limited in their ability to provide casualty care because a critical function that must be performed is the communication of treatment information during casualty evacuation. Such information is vital for maintaining the continuity of care as the casualty moves from one echelon of medical treatment to another. Therefore, all the different facilities along the chain of evacuation must be components of a single system.

The objectives of OMIS are to automate a patient medical record for operational environments and to provide the structure needed to insure the interoperability of systems at various echelons of medical treatment. This paper will describe the basic nature of the operational medical record and how it relates to facets of medical readiness. In addition, the basic design concepts of OMIS and their relationship to system objectives and operational constraints will be discussed.

OPERATIONAL MEDICAL RECORD

The operational medical record is not a complete inpatient record but it is limited to the information required to monitor the readiness of personnel in the field and to document the data needed at successive treatment echelons to assure the continuity of care during the evacuation of combat casualties. Although this record is not completely defined, a preliminary combat medical record has been developed for the FMF[6]. From this work some basic components of the operational record can be outlined to illustrate the type of information that will be processed in OMIS.

Data on routine care will be maintained in OMIS so the health maintenance programs can be carried out, the deployability of personnel can be monitored, and critical medical history items can be kept in an electronic format. Medical surveillance of deployed personnel requires a system that documents workplace exposures to hazardous materials and a method for examining all potentially affected people. Monitoring the medical readiness of personnel requires a system for reviewing the status of immunizations and dental examinations and compiling a list of individuals

who are due for examination. Finally, the medical history of combat personnel must be kept up-to-date so that in a crisis, information such as blood type and allergies will be accessible through OMIS as soon as treatment is possible.

In addition to routine care data, information on the treatment of illness and injuries will be obtained. While in garrison these data are used for required management reports. During combat these data can be coordinated among the different echelons of medical care. Also needed during combat are data on vital signs and disposition. Vital signs information not only allows changes in a patient's status to be monitored but also can be used to manage triage. Disposition information is needed for personnel accounting and medical regulating. Finally, vital signs and data on other signs and symptoms can be used for computer-aided diagnosis at remote clinics and for independent duty corpsmen.

This discussion has not been intended to be a complete outline of the operational medical record. Instead, sampling of the content of the operational medical record has been given to indicate the general scope of the data that will be collected and stored.

SYSTEM CONSTRAINTS

There are some constraints on the way OMIS can be configured because it is being developed for operational environments. For instance, OMIS must be an extremely rugged system. The FMF hardware must function in field environments and must be able to withstand the effects of dust, heat extremes and variations in electrical power. Similarly, a system developed for shipboard use must function when exposed to moist air, be unaffected by the ship's movement, and be highly compact so it takes a minimal amount of space. In addition, systems for operational environments must be designed to be operated by corpsmen or other personnel trained for field duty and who do not have extensive experience with computers.

Not only must field hardware be able to operate in hostile environments, it must be transportable. So, the devices that are to be employed in the field must be accompanied by a rugged storage case or packing material that will protect them during shipment. Again, compact systems appear to be required.

DESIGN DECISIONS

To develop a system that meets the objectives of OMIS within the constraints identified a number of design decisions were made. First, it was decided that OMIS should consist of a set of subsystems. These subsystems correspond to the three different types of facilities where OMIS will operate (i.e., FMF medical companies, shipboard medical departments, and remote clinics). This way hardware and system functionality can be tailored to the specific application.

A primary objective of OMIS, however, was to unify the processing of medical information in operational environments to insure system interoperability. One method used to achieve this goal is the utilization of a common set of software tools. During the development of OMIS a library of software tools will be built and maintained. Then the various subsystems will be assembled from the tools in this library. Therefore, functions common to different subsystems will be implemented with the same software.

To meet the requirement for rapid and accurate communication among echelons of medical treatment, a standard data transfer medium will be used. At present it is not expected that it will be possible to use radio communication among different echelons reliably. Thus, as patients are transported their medical data will accompany them encoded on a standard storage medium that can be decoded at any treatment facility. Currently, the best candidate for the standard storage medium is the electronic data tag. This device, which has been evaluated for use in combat environments, consists of an alterable semi-conductor encapsulated in plastic(6).

SUMMARY AND CONCLUSIONS

Rather than being a single comprehensive system to be used in all types of operational environments OMIS consists of a set of subsystems which are tailored for different types of environments. Thus, OMIS is defined by the aggregate of these subsystems and the standards developed to unify them. The crucial features that form the heart of OMIS are the library of software tools used to develop the different applications and the standard data dictionary which provides the needed structure.

Selecting an appropriate programming language is crucial for developing a system with the above attributes in a timely manner. Many management information systems have been developed in COBOL so that language might appear to be appropriate for OMIS. However, Munnecke and Pettis observed that COBOL programs tend to be long and difficult to modify and attribute these characteristics to overspecification(7). They argue that too many parameters such as field and record length must be explicitly determined. COBOL is not unique in this regard, however; many other languages including FORTRAN and BASIC require a high degree of parameter specification. Therefore, these languages also tend to suffer the same drawbacks as COBOL for this type of application. In addition, it is difficult to handle string data in FORTRAN, and the high degree of effort required to pass data among BASIC routines makes modular programming very difficult in that language.

Munnecke and Pettis state that one language that avoids the problem of overspecification is MUMPS(7). Moreover, Bowie has pointed out, MUMPS combines a number of powerful features including highly flexible string processing, a concise interpreted nature, a straightforward I/O structure, a hierarchical database, and the transparent integration of database elements into basic language syntax(8). The result is a highly tuned tool for programmer productivity and application development which is ideal for information systems that can be easily maintained and updated.

The attributes of MUMPS, then, give it the flexibility required to maintain software tools, to modify software quickly and efficiently, and to support the complex data dictionaries that allow databases to be modified rapidly and enable interactive query systems to be developed. These features of MUMPS are considered important because OMIS is expected to be a dynamic system where changes will be required to accommodate tactical innovations, new medical doctrine, medical innovations, technological developments, or changes in accepted medical practice. In addition, Munnecke and Pettis point out that a routine written in ANS MUMPS is complete and executable on any ANS MUMPS system(7). So, if different types of hardware are selected for different operating

environments (e.g., ships and FMF medical companies), identical routines could be used on both systems as long as ANS MUMPS could be implemented on both systems.

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The Operational Medical Information System (OMIS) is a program for developing an automated system for routine and casualty care. To accommodate the range of operational environments OMIS must include, three subsystems are planned. The subsystems correspond to the three primary types of operational medical facilities; the Fleet Marine Force medical company, the shipboard medical department, and remote shore clinics. The interoperability required among these subsystems is accomplished by maintaining a single library of software

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tools and developing the separate subsystems using these tools, by using a common data dictionary, and by using a standard medium for data transfer. To develop such a system quickly and efficiently MUMPS has been selected as the software environment for OMIS.

THE FLEET MARINE FORCE COMBAT CASUALTY MEDICAL INFORMATION SYSTEM:

AN OVERVIEW

LCDR M. W. Congleton, MC, USNR

Abstract

A medical information system for the Fleet Marine Force (FMF) should be capable of supporting medical and tactical requirements in garrison and in the field. This paper considers the field component of such a system. The medical treatment of a combat casualty is more difficult than the treatment of illnesses and injuries in a civilian setting because treatment under combat conditions must be carried out while the patient moves through the evacuation chain. In order to insure continuity of care during the evacuation process, systematic communication of casualty information between echelons of evacuation is critical. Specific information needs to be documented at each step of treatment and passed through the evacuation chain with the casualty to assure the patient receives the best possible medical care. Data elements were identified as being required or optional for each echelon of care, and forms were designed to include these data elements. Suitable data capture/processing equipment appropriate for a field environment was then chosen for the prototype system. Software is being developed which will make possible the tracking of individuals, the calculating of trauma scores, and the recording of specific details concerning injuries and treatments received by the casualty. This information can be used to print data sheets for inclusion in the permanent patient record and reports to medical regulating agencies and commands responsible for supply/resupply needs, personnel accounting, epidemiology, and medical intelligence.

INTRODUCTION

The medical treatment of a combat casualty is more difficult than the treatment of illnesses and injuries in a civilian setting because treatment under combat conditions must be carried out while the patient is moved through echelons in the evacuation chain: echelon I (Field Corpsman), echelon II (Battalion Aid Station), echelon III (Medical Company), echelon IV (Helicopter or Beach Evacuation Station), and echelon V (Force Hospital).[1] In designing a combat casualty medical information system for the Fleet Marine Force (FMF), the data required at each echelon need to be identified, forms on which to record these data need to be designed, suitable data capture/processing equipment needs to be chosen for use in a field environment, and software developed which will perform the necessary FMF functions.

DATA ELEMENT REQUIREMENTS

Previous workshops[2,3,4] created committees to consider data element requirements of the various echelons. Committee members agreed that the data collected at each echelon of the medical organization should be confined to the minimal information necessary for the treatment of the patient at the next higher echelon. This restriction was imposed by the reality that only brief

and readily obtained information could be collected by medical personnel working under the pressures of combat. The data recorded by each echelon should also be sufficient to permit reconstruction of clinically important events in the patient's history.

In September 1983, a working group convened at the Naval Health Research Center, San Diego, to consolidate the recommendations of these workshops concerning the minimal data required for echelons I, II and III. Those elements included identification data, demographic data, brief medical history, presenting problems, vital signs, provider I.D., facility, injuries, procedures/treatments, medications, and final disposition from echelon II. Data elements unique to echelon III included patient management, triage disposition, laboratory tests, operative procedures, provider orders/notes, and final disposition (Appendix I).

DEVELOPMENT OF FIELD COMBAT CASUALTY FORMS

The Naval Health Research Center then designed a form which contained data elements unique to echelons I and II (Figure 1). This form makes maximum use of checklists and body charts to record injuries and treatments. It is possible to print this form on mylar and thus make it virtually indestructable. The body charts could also be embossed to make their location in low light conditions easier. Side one of the form contains sections for recording basic demographic information, vital signs, trauma score, injuries, treatments, tubes, and anesthetics. Side two includes sections for recording medications, triage classifications, final disposition, and provider notes.

This form can be rapidly filled out by the field corpsman. Basic demographic data is recorded from the casualty's dog tag, and instead of taking time to write out descriptions of injuries and treatments as required with the U.S. Field Medical Card, the revised form can be completed quickly to indicate the site and type of injury and site and type of treatment.

When the casualty arrives at the Battalion Aid Station, the form can be reviewed and updated while the casualty receives further treatment. The Battalion Aid Station is equipped to take a complete set of vital signs. These data can be recorded in the area provided on the form and converted to a trauma score[5-6] using the table included on the side of the form. The trauma score is a global index of the severity of an injury which can be expressed as a probability of survival. This can serve as a guide for corpsmen when assigning priorities to patients for treatment or evacuation to the Medical Company.

A casualty arriving at the Medical Company is taken to the triage area where he is further examined and assigned a triage disposition of either minimal, delayed, urgent or expectant. By computing a probability of survival from the casualty's trauma score at echelon II, the triage officer at echelon III would have an objective guide for quickly assigning a triage disposition to the casualty. At the Medical Company, a permanent record is created, and the form becomes a part of that record. The form was designed so that it can be folded for easy handling in the field. When it is unfolded, it is the size of a standard page and can be added directly to the patient's record, thus avoiding the loss of important information.

DATA CAPTURE AND DATA PROCESSING

A portable computer terminal at echelon II could expedite data capture and data processing activities. Portable computer terminals designed for 'harsh' industrial environemnts are appropriate for the conditions encountered at echelon II, and they perform all the required functions. Several models are battery powered and light enough in weight to be hand held. Some features of these models include an expanded memory, a full keyboard and input/output ports to allow the interfacing of various peripheral devices. Many of these models also contain a time/date clock so that any reading event can be associated with time. The portability of these terminals in a combat situation is a critical feature. Being able to move the terminal to the source of the data, the casualty, reduces the risk of a possible mix up of data. Encoded medications and treatments could be read, and the original source of the information need never be separated from the casualty. These portable terminals could also be used at the exit point from echelon II where data from a casualty or group of casualties could be read, accumulated, and forwarded via a communications link in preparation for the casualties arriving at echelon III.

A microcomputer could be used at echelon III to further facilitate data capture and data processing activities. In the triage area at echelon III, the microcomputer could process data on incoming casualties and record specific details concerning injuries and treatments received by the casualty. This information can then be used to print data sheets for inclusion in the permanent patient record and reports to medical regulating agencies and commands responsible for supply/resupply needs, personnel accounting, epidemiology, and medical intelligence.

Data capture at echelons I and II could be accomplished with bar code readers, data tag readers, etc. Bar code is the most used and reliable method of data entry of short string forms. Most of the schemes for bar coding in common use have built-in error checking which reduces the error rate to less than one in three million. In 1982, military standards were published identifying code 39, a standard bar code type, as a way of marking all supplies and materials being provided to the Department of Defense and Government Services Agency. This includes all medical supplies. Thus, bar code technology could be used for material control as well as retrieval of information from the medical card.

Data tags are alterable semiconductor memory devices used for the storage of various types of information. These devices are relatively small and durable. They are commonly supplied in the shape of a key or a dog tag. In this technology, erasable programmable read only memories are encapsulated in a non-conductive, heat resistant polymer to protect the semiconductor while leaving the electronic contacts exposed. Information is passed to and from the device via a serially interfaced data tag reader. Current memory capacities of data tags are adequate to store the average medical record.

CONCLUSION

The design of a combat casualty care information system for the FMF requires a consideration of the medical and tactical needs of each echelon in the evacuation chain. Data elements have been identified as required or optional for each echelon, forms have been designed for use in recording these data, and data capture/processing equipment appropriate for a field environment

has been chosen for the prototype system. The relative advantages of various data collection forms and hardware configurations will be evaluated through future field testing in an FMF operational environment.

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LAST NAME	FIRST NAME	M. I.	SOCIAL SECURITY NUMBER

PATIENT MANAGEMENT

TREATMENT FACILITY	FIELD CORPSMAN		BATTALION AID STA		MED/HOSP CO		FLEET HOSPITAL	
ARRIVED	Date	Time	Date	Time	Date	Time	Date	Time
TREATMENT	Date	Time	Date	Time	Date	Time	Date	Time

VITAL SIGNS

DATE	TIME	TEMP	PULSE	BLOOD PRESSURE SYS / DIAS	RESP RATE	RESP EXPAN	CAP REFILL	EYE OPEN	VERBAL RESPON	MOTOR RESPON
				( )/						
				( )/						
				( )/						

INJURIES

TYPE OF INJURY

1. DISLOCATION
2. FRACTURE
3. LACERATION
4. PUNCTURE
5. TRAUM AMPUTATION
6. WOUND
7. CONCUSSION
8. WHITE PHOS BURN
9. OTHER BURN
10. OTHER INJ.

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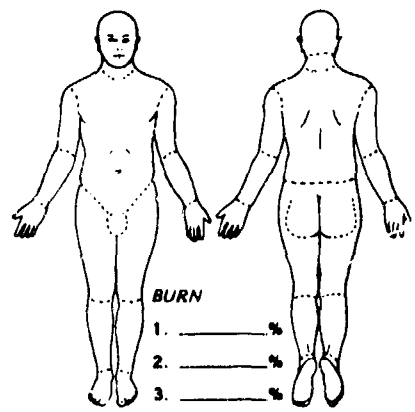

BURN

1. ________%
2. ________%
3. ________%

TRAUMA SCORE

[illegible]	[illegible]	4
	[illegible]	3
	[illegible]	2
	[illegible]	1
	[illegible]	0
[illegible]	[illegible]	4
	[illegible]	3
	[illegible]	2
	[illegible]	1
	[illegible]	0
[illegible]	[illegible]	1
	[illegible]	0
[illegible]	[illegible]	2
	[illegible]	1
	[illegible]	0

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
11	[illegible]
10	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
7	[illegible]
[illegible]	[illegible]
[illegible]	4
4	[illegible]
[illegible]	1
[illegible]	0
1	[illegible]

GLASGOW COMA SCALE

EYE OPENING	[illegible]	4
	To Voice	3
	To Pain	2
	None	1
VERBAL RESPONSE	Oriented	5
	Confused	4
	[illegible]	3
	[illegible]	2
	None	1
MOTOR RESPONSE	Obeys Commands	6
	Localizes Pain	5
	[illegible]	4
	[illegible]	3
	[illegible]	2
	None	1

[illegible]	
[illegible]	[illegible]
11	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

TRAUMA SCORE
COMA SCORE

TREATMENTS

1. BANDAGE
2. TOURNIQUET
3. SPLINT
4. APPLY HEMOSTAT
5. TRACHEOTOMY
6. SUTURES
7. OXYGEN
8. DECONTAMINATION
9. CAST
10. OTHER:

____

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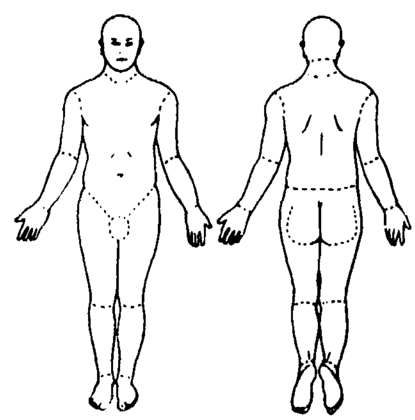

TUBES

1. ENDOTRACH
2. CHEST
3. N G
4. FOLEY CATH

ANESTHETICS

REGIONAL

1. SADDLE BLOCK
2. EPIDURAL
3. AXILLARY
4. I V

FIELD

1. XYLOCAINE
   A. W/EPI
   B. W/O EPI

Figure 1, Side 1

MEDICATIONS

	DOSE	ROUTE PO/IM/IV/SUBQ	DATE	TIME	DATE	TIME	DATE	TIME
NARCOTICS MORPHINE OTHER								
SEDATIVES DIAZEPAM OTHER								
ANTIBIOTICS PENICILLIN TETRACYCLINE SULFA OTHER								
ANTIDOTE ATROPINE OTHER								
TOPICAL SPECIFY								
IMMUNIZATIONS TETANUS TOXOID VACCINE OTHER								
OTHER MEDICATIONS								
I V SOLUTIONS RINGERS NORMAL SAL D5W OTHER		GAUGE NEEDLE						

TRIAGE CLASSIFICATION

1. MINIMAL
2. DELAYED
3. URGENT
4. EXPECTANT

FINAL DISPOSITION

- ☐ RETURNED TO DUTY
- ☐ EVACUATED - MODE:
  - ☐ AIR
  - ☐ LAND
  - ☐ SEA
- ☐ OTHER: ____________
- ☐ DIED OF:
  - ☐ BATTLE INJ
  - ☐ NON-BATTLE INJURY
  - ☐ DISEASE
  - ☐ BURNS
  - ☐ SUICIDE
  - ☐ CHEM. AGENT
  - ☐ BIOLOGICAL AGENT
  - ☐ RAD. AGENT
  - ☐ OTHER: ____________

PROVIDER NOTES

Figure 1, Side 2

COMBAT MEDICAL RECORD

DATA ELEMENTS	*IN GARRISON*	*ECHELONS*		
		ECHELON I	*ECHELON II (BAS)*	*ECHELON III*
Identification Data				
Name	Recorded on Data Tag	Required Information	Required Information	Required Information
SSN/Family Member Prefix	↓	Required Information	Required Information	Required Information
Date of Birth	↓	Optional Information	Optional Information	Optional Information
Sex	↓	Optional Information	Optional Information	Optional Information
Demographic Data				
Paygrade or Rank	Recorded on Data Tag	Optional Information	Optional Information	Optional Information
Country	↓	↓	↓	↓
Branch of Service	↓	↓	↓	↓
Race	↓	↓	↓	↓
Religion	↓	↓	↓	↓
Brief Medical History				
Allergies (Most Recent)	Recorded on Data Tag	Required Information	Required Information	Required Information
Blood Type	↓	Optional Information	Optional Information	Required Information
Immunization Status *(Smallpox, Typhoid, Tetanus, Cholera, Yellow Fever, Plague, Polio, Influenza)*	↓	Optional Information	Optional Information	Optional Information
Heart Irregularity	↓	Required Information	Required Information	Required Information
Unequal Pupils Normal	↓	Required Information	Required Information	Required Information
Presenting Problems				
Problem List			Problem List Recorded	Problem List Recorded Chart of Body Parts and Organs Marked as to What and Where
Provider I. D.			Recorded	Recorded
Facility No.			Recorded	Recorded
Vital Signs				
Temperature			Repeated Measurements Recorded Along with Time *(Date/Hour/Min.)*	Repeated Measurements Recorded Along with Time *(Date/Hour/Min.)*
Pulse			↓	↓
Respiratory Rate			↓	↓
Respiratory Effort (Expansion)			↓	↓
Systolic Blood Pressure			↓	↓
Diastolic Blood Pressure			Not Measured at Echelon II	↓
Verbal Response: 1. Oriented 2. Confused 3. Inappropriate Words 4. Nonunderstandable 5. None			Repeated Measurements Recorded Along with Time *(Date/Hour/Min.)*	↓
Eye Opening: 1. Spontaneous 2. To Voice 3. To Pain 4. None			↓	↓
Motor Response: 1. Obeys Commands 2. Withdrawal 3. Flexon 4. Extension 5. None			↓	↓
Capillary Refill: 1. Less than 2 Seconds 2. 2 Seconds or Greater			↓	↓
Mental Status Exam		Abbreviated Exam Recorded	Further Description Recorded	Mental Status Exam Recorded
Glasgow Coma Scale: Scale; Trauma Score/Probability of Survival		Recorded Along with Time *(Date/Hour/Min.)*	Repeated Measurements Recorded Along with Time *(Date/Hour/Min.)*	Repeated Measurements Recorded Along with Time *(Date/Hour/Min.)*
Triage Category: 1. Minimal 2. Delayed 3. Immediate 4. Expectant			Optional Measurement	Recorded
Provider I. D.		Recorded	Recorded	Recorded
Facility No.			Recorded	Recorded

COMBAT MEDICAL RECORD (Cont'd)

DATA ELEMENTS	IN GARRISON	ECHELONS		
		ECHELON I	ECHELON II (BAS)	ECHELON III
Injuries				
Time of Injury *(Date/Hour)*		Recorded	Further Description Recorded	Further Description Recorded
Body Part				
Type of Injury:				
Dislocation				
Fracture				
Laceration				
Puncture				
Traumatic Amputation				
Wound				
Burns:				
3° ____ 2° ____ 1° ____				
% of Body Area				
Procedures/Treatments				
Tourniquet		Time *(Date/Hour/Min.)* Applied and Removed Recorded	Time *(Date/Hour/Min.)* Applied and Removed Recorded	Time *(Date/Hour/Min.)* Applied and Removed Recorded
Splints		Type and Location Recorded	Type and Location Recorded	Type and Location Recorded
Bandages		Recorded	Recorded	Recorded
Tracheotomy		Recorded	Recorded	Recorded
Tubes *(Endotracheal, Chest, NG, Foley Catheter)*			Type Recorded	Type Recorded
Casting/Immobilization:			Recorded	Recorded
Body Part				
Method				
IV Solutions:			Recorded	Recorded
Ringers Lactate				
Normal Saline				
D5W				
Other *(Specify)*				
Time Started				
Location				
Gauge Needle				
Sutures			Recorded	Recorded
Oxygen Administration:			Recorded	Recorded
Time Started				
%				
Medications				
Narcotics:		Recorded (Dose and Times [Date/Hour/Min.])	Recorded (Dose and Times [Date/Hour/Min.])	Recorded (Dose and Times [Date/Hour/Min.])
Morphine				
Antibiotics:				
Penicillin				
Sulfa				
Antidotes:				
Atropine				
Immunizations:				
Tetanus:				
Toxoid				
Vaccine				
Serum				
Other *(Specify)*				
Route of Administration				
Provider I. D.				
Facility No.				
Anti-arrhythmics				
Pre-op Medications				
Final Disposition from Echelon II				
Treated and Returned to Field			Recorded	
Evacuated by:				
Air				
Boat				
Field Litter				
Ambulance				
Died of Wounds				
Other *(Specify)*				
Medical Officer I. D.				
Facility No.				

COMBAT MEDICAL RECORD (Cont'd)

DATA ELEMENTS	IN GARRISON	ECHELONS		
		ECHELON I	ECHELON II (BAS)	ECHELON III
Laboratory Tests				
Type of Test:				Tests Ordered and Results Recorded
CBC				
Urinalysis				
Blood Type and Crossmatch				
Electrolytes				
Blood Gases				
Culture:				
Sputum				
Stool				
Throat				
Urine				
Wound				
Other *(Specify)*				
Result(s)				
Organism I. D.				
Resistance Pattern				
Attribute Pattern				
Provider I. D.				Recorded
Facility No.				Recorded
Patient Management at Echelon III				
Received by:				Recorded
Air				
Boat				
Field Litter				
Ambulance				
Time of Arrival				
Time Seen				
Time into OR				
Facility No.				
Triage Disposition at Echelon III				
Morgue				Recorded
X-ray				
OR (Major Surgery)				
OR (Minor Surgery)				
ICU				
Decontamination Treatment				
Primary Ward				
Overflow Ward				
Triage Medical Officer I. D.				
Facility No.				

COMBAT MEDICAL RECORD (Cont'd)

DATA ELEMENTS	IN GARRISON	ECHELONS		
		ECHELON I	ECHELON II (BAS)	ECHELON III
Operative Procedure				
Time *(Date/Hour/Min.)*				*Recorded*
Type of Procedure:				
R - Repair				
D - Debride				
X - Excise				
P - Amputate				
O - Other *(Specify)*				
Chart of Body Parts and Organs Marked for Location of Procedure				
Anesthetic Type:				
GENERAL				
H - Halothane				
E - Ether				
N - Nitrous Oxide				
REGIONAL				
SAB - Saddle Block				
EPDL - Epidural				
AX - Axillary				
IV - Intravenous				
FIELD				
Xylocaine:				
With epinephrine				
Without epinephrine				
Pontocaine				
Administration Time *(Date/Hour/Min.)*				
Special Procedures *(Text)*				
Remarks *(Text)*				
Intensive Care:				
Time *(Date/Hour/Min.)*				
Summary *(Text)*				
Medical Officer I. D.				
Surgeon I. D.				
Facility No.				
Provider Orders/Notes				
Orders				Recorded
Provider I. D.				
Notes				
Provider I. D.				
Summary (Text)				
Facility No.				
Final Disposition from Echelon III				
Treated and Returned to Field				Recorded
Evacuated by:				
Air Vehicle				
Land Vehicle				
Sea Vehicle				
Died of:				
Battle Injuries				
Non-Battle Injuries				
Burns				
Chemical Agent				
Disease				
Suicide				
Other *(Specify)*				
Medical Officer I. D.				
Facility No.				

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Combat casualties   microchip tags
Evacuation chain
Trauma care
Data tags

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A medical information system for the Fleet Marine Force (FMF) should be capable of supporting medical and tactical requirements in garrison and in the field. This paper considers the field component of such a system. The medical treatment of a combat casualty is more difficult than the treatment of illnesses and .njuries in a civilian setting because treatment under combat conditions must be carried out while the patient moves through the evacuation chain. In order to insure continuity of care during the evacuation process, systematic

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communication of casualty information between echelons of evacuation is critical. Specific information needs to be documented at each step of treatment and passed through the evacuation chain with the casualty to assure the patient receives the best possible medical care. Data elements were identified as being required or optional for each echelon of care, and forms were designed to include these data elements. Suitable data capture/processing equipment appropriate for a field environment was then chosen for the prototype system. Software is being developed which will make possible the tracking of individuals, the calculating injuries and treatments received by the casualty. This information can be used to print data sheets for inclusion in the permanent patient record and reports to medical regulating agencies and commands responsible for supply/resupply needs, personnel accounting, epidemiology, and medical intelligence.

PRELIMINARY SPECIFICATIONS FOR A SHIPBOARD MEDICAL INFORMATION SYSTEM

LCDR James C. Helmkamp, MSC, USN

Abstract

The development of a shipboard medical information system presents a unique challenge because of the complex array of habitability and work milieus to which personnel are continuously exposed and the varied operational conditions under which they must perform. Efficient and reliable Medical Department management is but a subset of the overall goal of providing a safe and healthful working environment for all naval personnel. The shipboard system must be "hardened" to these harsh environments yet have the adaptive capacity to interface with existing databases. Further, it must produce reliable medical information on worker health status for clinical, administrative or other professional decisions, and provide the extensive and dynamic cross-referencing and rapid data retrieval necessary for an occupational surveillance network.

INTRODUCTION

An essential contributing factor in the successful conduct of Navy operations is the sustainability of crews manning ships and aircraft. Maintaining the health of these vital personnel resources is axiomatic if ships are to maintain maximum operational readiness. The shipboard environment is a complex array of habitability and work milieus which present a broad range of biological, physical and chemical stressors to which personnel are continuously exposed.

The Occupational Safety and Health Act of 1970 [1] requires the performance and documentation of a variety of industrial hygiene and occupational health services designed to protect the health of American workers. The provisions of this Act were extended to federal employees by Executive Order 12196[2] which specified that Federal Agencies are to develop and implement automated data processing (ADP) applications to OSHA related data handling. Various Department of Defense and Department of the Navy directives [3-6] outline responsibility for the implementation of the Navy Occupational Safety and Health (NAVOSH) program whose main tenet is directed towards the creation and maintenance of a safe and healthful working environment for all naval personnel. The NAVOSH program is an integrated effort comprising both line and medical components. The line component is primarily directed towards safety with medical efforts focused on health. Areas of medical cognizance include industrial hygiene, environmental health, epidemiology, occupational medicine, and medical surveillance of personnel. Within this frame of reference the charter of the Navy Medical Department is to successfully integrate required program elements with current medical doctrine into an aggressive and comprehensive program whose primary goal is to safeguard the health and welfare of naval personnel.

This paper will discuss some of the typical functions of independent duty corpsmen and how current information handling techniques, associated with these functions, impact on the efficiency and effectiveness of fleet medical departments. The objectives to be achieved by a comprehensive shipboard medical information system will be discussed in terms of mandated occupational health and safety requirements, and required system flexibility and reliability necessitated by ship type, mission requirements and operating schedules.

BACKGROUND

Intense and comprehensive occupational health surveillance requires workplace monitoring and personal medical surveillance components. Workplace monitoring includes those routine measures typically within ship's force capability, e.g., heat, noise, physical hazards, and limited chemical or biological measures. Evaluations beyond the ship's capability are functions of those commands tasked with technical support responsibilities. Medical surveillance involves the establishment and monitoring of the health status of personnel as it relates to their job environment or occupational specialty. The comprehensive medical examination is the core of this surveillance and is designed to provide specific information for assessing hazards and commensurate levels of protection. Such information includes medical histories, physical examinations, clinical laboratory tests, and occupational histories.

The manpower and resources necessary to satisfy these needs, on a routine and continual basis, must be viewed in terms of how they impact on overall Medical Department functions that include routine and emergency medical care, administrative, supply and fiscal management, medical equipment readiness and maintenance, patient and record management, and training.

Occupational health and preventive medicine functions comprise only a portion of the overall duties that an independent duty corpsman (assigned to an operational fleet unit) is required to perform. As Table 1 indicates there is a wide range of activities that a corpsman must have knowledge of including administering first aid and handling of medical emergencies to the potability of water and correct holding temperatures for food products. These activities are grouped into four functional areas: clinical support, preventive medicine and occupational health, workload-morbidity reporting, evaluation and projection, and medical adjunctive service. These functions are not comprehensive for type and class of ship and the list does not assign priority to these specific duties.

To store, process and retrieve data in forms that efficiently monitor shipboard environments, the health of personnel who live and work in these environments and contribute to the overall readiness of the ship's Medical Department requires an ADP capability which currently does not exist.

CURRENT INFORMATION HANDLING DEFICIENCIES

Current handling of medical records and associated information retrieval within Fleet Medical Departments is manual- and labor-intensive. Sickbays performing routine medical care and specialized occupational health services rely on manual tickler files. These services are not based on

accurate or current exposures. Examination results are recorded only in the hard copy medical record. All laboratory and other relevant forms must be produced and documented by hand. Thus, use of medical information in a variety of other capacities is severely limited. Some of the deficiencies that currently exist in fleet Medical Departments include:

(1) Inability to store, process and retrieve occupational and environmental data which precludes the timely identification and scheduling of requisite physical examinations, formatting and display of individual exposure histories, formulation of intervention strategies, and assessment of standards compliance.

(2) Inability to automatically schedule and track personnel for routine medical/dental functions (immunizations, dental work, eye exam, audiogram) and then reliably annotate records with results.

(3) Inability to automatically generate and maintain a database of required reports at the Command and Type Commander level (bacteriological, sanitation, monthly morbidity, etc.).

(4) Lack of an ADP capability to enable more efficient ordering, purging and quality control of medical supplies, including medicines and drugs and emergency medical equipment.

(5) Lack of ADP and associated database that enhances the timely identification and assessment of hazards responsiveness, identification of workloads and associated resource requirements, and a capability to network (software compatability) with existing shore databases, such as the Navy Occupational Health Information Management System (NOHIMS), for purposes of epidemiological research.

OBJECTIVES OF A SHIPBOARD MEDICAL INFORMATION SYSTEM

Twelve Senior Medical Department Representatives, from a variety of Pacific Fleet surface ships, were recently interviewed assessing factors associated with the effectiveness of shipboard Independent Duty Corpsmen. One of the areas covered in this interview was ADP support for sickbay. Not a single corpsmen of the twelve questioned the value of ADP support, even if they admitted knowing almost nothing about computers. Corpsmen stated that ADP seem to offer "potential assistance" in nearly all phases of Medical Department administration. The most common applications mentioned, included (1) drafting reports, (2) tickler file management, (3) supply and equipment inventory and fiscal management (4) treatment log, and (5) diagnostic assistance. Several of the corpsmen indicated that they were currently using their own personal computers to assist in some of these areas. Although caution should be exercised in generalizing from this limited number of interviews to the entire fleet, the responses were unequivocal.

Two areas where a comprehensive shipboard medical information system will have its greatest impact are occupational surveillance and Medical Department resource management. Specifically, acquisition of appropriately developed hardware and software to handle occupational surveillance data will assist corpsmen in (1) conducting a comprehensive and reliable occupational surveillance program, (2) providing continuous medical and environmental surveillance, (3) reviewing information and data predictive of potential hazards, and (4) analyzing health trends by specific exposure, environment and demographic parameters, individually or population based.

This hardware and software will enhance shipboard Medical Department resource management by allowing, (1) efficient patient and record management, (2) continuous monitoring of medical supply and equipment quality control and usage rates, (3) more prudent use of operating funds, (4) the establishment of "administrative" databases that will generate required reports, identify patterns and potential problem areas, and (5) interfacing with other shipboard databases, such as the Shipboard Nontactical Automatic Data Program (SNAP), but maintaining appropriate security on medical information.

A prime consideration in system concept, software development, and hardware acquisition is the number and types of ships to which this system will be applied. Mission requirements and operating schedules, which may vary from ship to ship, will play a key role in developing a Medical Information System that can provide the required flexibility and reliability in often adverse operating environments.

Table 2 presents a perspective on the size of the surface fleet, (by class and general function) and the average complement of men and women aboard. For purposes of this paper these numbers represent figures provided in Janes' Fighting Ships [7] and the projected figures are subject to change.

Therefore, to provide a safe and healthful working environment on vessels of all sizes, special considerations will have to be made in the design and development of the shipboard medical information system for the support ships and craft with average complements less than 100.

This system is a major subset of a global Operational Medical Operation System (OMIS) that is currently being developed by the Navy. The objectives of OMIS are, in part, to (1) develop information processing technologies to enhance medical support of the Marine Corps and Rapid Deployment Operations, (2) develop medical information systems designed to manage personal, medical and environmental data in support of acute and routine patient care in field and operational medical facilities, and (3) provide a Navywide medical recordkeeping and reporting system for operational environments: Figure 1 provides an overview of OMIS and the integration of the functional modules.

SUMMARY

This paper has summarized the current deficiencies of information handling techniques within Fleet Medical Departments. The long-range objectives of a comprehensive shipboard medical information system have outlined means to enhance efficient and reliable Medical Department management especially in terms of the unique shipboard environment in which independent duty corpsmen live and work and the varied functions that they perform. The development of such a system would also make significant contributions towards providing optimum medical care in a safe and healthful working environment.

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Table 1

Typical Functions of an Independent Duty Corpsman

I. Clinical Support

- Routine physical exams
- Immunizations
- Eye tests
- Hearing tests
- Dental exams
- Weight control program
- Specialty physical exams
- Health and physical readiness program
- Pharmacy
- Routine and specialized lab tests
- X-ray procedures
- PRP screening
- Medical and dental record management

II. Preventive Medicine and Occupational Health

- Sanitation inspections: food service, barber shop, laundry, quarters, etc.
- Vector and insect control
- CHT system
- Potable water system
- Heat/humidity surveys and reports
- Deratization (rat extermination)
- Hearing conservation
- Occupational noise control
- NAVOSH program
- Quarantine declaration
- Asbestos surveillance
- Radiological safety and situational reports
- TB screening-control follow-up
- Sexually transmitted disease control program

III. Workload/Morbidity Reporting, Evaluation, and Projection

- Medical record census
- Binnacle and sick lists
- Medical services/outpatient morbidity report
- Current Ships Maintenance Project (CSMP)
- Disease alert reports
- Accident or injury recordkeeping and reporting
- Medical Department journal

IV. Medical Adjunctive Services

- Medical fund accounting
- Authorized Medical Allowance List (AMAL): requisition, inventory, quality control, survey
- Record retirement
- Emergency medical support equipment and supplies: Unit one, gunbags, first aid boxes, antidote lockers, battle dressing stations, biological warfare - chemical warfare supplies, etc.
- Casualty drills
- Training: quarterly and long range, first aid qualification, specialty
- Watch quarter and station bill

Table 2

Type of Ship, Complement and Projected Growth of U. S. Navy Surface Forces

Type	1981[a]	1987[b]	Average Complement
Aircraft Carriers	15	17	5200[c]
Battleships	1	3	1600
Cruisers	31	52	525
Destroyers	93	94	335
Frigates	110	117	235
Amphibious	66	68	800[d]
Auxilliary	93	98	825
Hospital	0	2	1000[e]
Total	409	451	

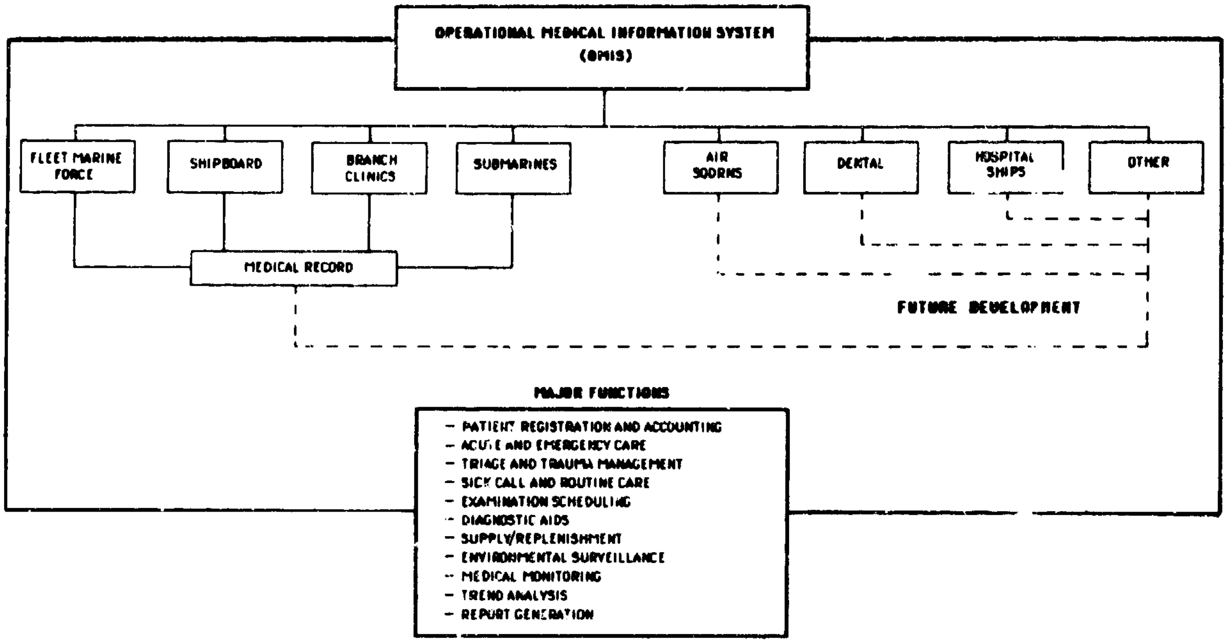
[a] Active, under construction, conversion

[b] Reagan Administration Planned 5-year Shipbuilding/conversion Program (FY 82-86)

[c] Includes Airwing

[d] Includes Troops

[e] Bed capacity



COMPONENTS OF THE NAVY'S OPERATIONAL MEDICAL INFORMATION SYSTEM

Figure 1

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

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Shipboard medical information system
Information handling techniques

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The development of a Shipboard Medical Information System presents a unique challenge because of the complex array of habitability and work milieus to which personnel are continuously exposed and the varied operational conditions under which they must perform. Efficient and reliable Medical Department management is but a subset of the overall goal of providing a safe and healthful working environment for all naval personnel. The shipboard system must be "hardened" to these harsh environments yet have the adaptive capacity to interface with existing data bases. Further, it must produce reliable medical

information on worker health status for clinical, administrative or other professional decisions, and provide the extensive and dynamic cross-referencing and rapid data retrieval necessary for an occupational surveillance network.

THE OPERATIONAL MEDICAL INFORMATION SYSTEM (OMIS) IN NAVY BRANCH CLINICS

CDR Frederic D. Glogower, MSC, USN, and Lawrence A. Palinkas, Ph.D.

Abstract

As part of the OMIS development, a systems analysis is being conducted to determine the organizational structure and reporting requirements of Navy branch clinics, the services provided, and the data elements required by each service. Results of the systems analysis will be used to develop a system design. Existing medical information systems offer guidelines for further development.

INTRODUCTION

The design of any comprehensive medical information system requires a thorough understanding of the institutional framework of the organizations utilizing such information.(1) This framework determines how information is obtained, processed, utilized, and disseminated. As part of the development of the Operational Medical Information System (OMIS), a systems analysis of the organizational structure and information needs of branch clinics providing medical, dental, occupational, and mental health services to navy personnel is required.(2) This analysis should focus on three specific aspects of organizational structure and medical information. The first aspect would concern the relationship between the patient and the clinic. Organizational procedures for meeting patient needs must be reviewed and the degree of integration of information needs from the perspective of patient needs and institutional framework should be analyzed. The second aspect would involve the relationship between the organization and the information itself. This information would include the field medical record and personnel, medical, and environmental data necessary to support routine and acute patient care, supply inventory, administrative functions, contingency planning, and epidemiologic analyses. The role of the institutional framework at each stage of the information processing sequence and the information needs as determined by organizational structure and actual day-to-day operations must be examined. The third aspect concerns the relationships between branch services within a clinic. In order to develop a comprehensive medical information system which can be utilized by each type of service, an understanding of existing formal and informal networks of information exchange and a comparison of the institutional framework of each type of clinic is required.

This paper provides a preliminary analysis of the operational and medical information needs of a Navy branch clinic. This analysis will include a discussion of the organization of an outpatient clinic, the medical information needs and existing levels of information flow, and the requirements for the design and implementation of a medical information system which will meet the needs of remote as well as CONUS (Continental United States) outpatient clinics.

ANALYSIS OF OUTPATIENT CLINIC ORGANIZATION

The first step in the description and design of an operational medical information system for outpatient clinics involves a systems analysis of the organizational structure and operation of major CONUS shore clinics. The Branch Clinic at the Naval Station, San Diego, California, served as the field site for this preliminary analysis. Analysis focused on the organizational structure of the clinic, its function, and its relationship with other branches and services of the U.S. Navy Medical Command. The components of health care provided by each branch within the clinic, including the number and type of personnel, their duties and responsibilities, were examined. A similar analysis is planned for one or more remote clinics such as El Centro, California, and/or Diego Garcia.

The Naval Station Branch Clinic is the headquarters of the Naval Medical Clinic, San Diego, and is one of several branch clinics in the San Diego area. A flow chart outlining the chain of command of the Naval Medical Clinic is provided in Figure 1. The offices of the Commanding Officer and the Directorates are located at the Naval Station Branch Clinic. The Naval Medical Clinic, San Diego, is responsible for providing comprehensive ambulatory medical care services to Navy and Marine Corps units of the operating forces, shore activities, and their authorized beneficiaries in the San Diego area. The primary functions of the clinic are to direct and coordinate the operation of subordinate medical care facilities; train and maintain designated personnel in an operationally ready status for augmentation of the operating forces; develop, operate, and manage administrative and logistical plans and programs in compliance with current directives; and maintain liaison with shore commands and units of the operating forces receiving medical care from the command.

Each branch clinic within the Naval Medical Clinic is directed by a Senior Medical Officer and is organized into three major divisions: The Administrative Division which is responsible for operational support, supply and staffing; the Clinical Division which provides primary and specialized medical care to outpatients; and the Ancillary Division which provides support to the clinical division. The organization of these divisions is outlined in Figure 2. Each of the branches within the three divisions currently reports independently to the Senior Medical Officer who also serves as head of the Administrative Division.

The Clinical Division at the Naval Station Branch Clinic consists of eight branches. Most outpatients are seen in primary care, which functions as sick call. Other branches include mental health, public health, optometry, pediatrics, obstetrics and gynecology, physical therapy, and special procedures (EKGs and other specialized exams). Each branch consists of one or more professionals, supported by hospital corpspersons with specialty training. General duty corpspersons augment the manpower. Nursing staff serve in a general supervisory capacity. Civilian clerks and/or typists offer clerical support. The primary responsibility of the clinical branches is to provide patient care. However, each branch is also responsible for managing its own scheduling, generation of reports, recordkeeping, supply and inventory.

The Administrative Division consists of four branches. The administrative branch coordinates and manages aspects of the other branches, involving personnel, operations, and fiscal management.

Patient administration is concerned with health records, CHAMPUS, and other patient affairs. Operating management is involved with services necessary to the day-to-day running of the clinic, such as security, linen control, and mail distribution. The fiscal/supply branch procures, maintains and issues supplies. A health care administrator oversees the management of the Administrative Division, with senior enlisted personnel heading each of the branches. A relatively large number of civilian workers provide clerical support. Duties involve correspondence, recordkeeping, maintainance of logs, and preparation of necessary reports.

In many respects, the CONUS clinics and remote clinics are organized in the same manner and provide the same type of primary care to outpatients. Nevertheless, certain differences do appear to exist with respect to structure and operation. The organizational structure of both types of outpatient clinics may be similar but the remote clinics are generally smaller in size and number of personnel and provide fewer specialized services. Which specialty services are provided in the remote clinic is usually based on the specific function of the naval facility where the clinic is located. For example, the Branch Clinic at the Naval Air Facility, El Centro, California, includes an aviation medicine branch. In addition, the staff is smaller and consists primarily of general medical officers who must see a wide variety of clinical cases spanning many specialties. For example, psychiatric cases examined by a psychologist or psychiatrist in the mental health unit at the Naval Station Branch Clinic are seen by a General Medical Officer in a remote clinic. Data needs and reporting requirements at the two settings may differ.

MEDICAL INFORMATION AND THE OUTPATIENT CLINIC

Within the branch clinic, medical information is used principally for clinical and administrative purposes. Clinical information includes illness and injury descriptions, x-ray and lab results, diagnoses and other clinical evaluations, treatment history, medications administered, and patient follow-up. All of this information is recorded in the patients' medical records. The ancillary branches are responsible for recording the number of services provided, including the number and types of x-rays and lab tests conducted and prescriptions filled. Administrative information pertains to staffing assignments, quality control, medical supplies, and cost accounting. Information for research purposes also is being collected on an ongoing basis in the mental health branch using the Navy Mental Health Information System (NAMHIS)[3].

Medical information within the Naval Station Branch Clinic currently utilizes a dual paper-computer system. The clinic is currently linked to the Naval Hospital, San Diego, through the Tri-Service Medical Information System (TRIMIS) and plans are underway to link the Naval Station mental health branch to the Naval Health Research Center using the NAMHIS system. For the most part, however, medical information is rocorded on paper in the form of medical logs, encounter forms, and medical records, and stored in file cabinets.

A description of the flow of information within the outpatient clinic is contained in Figure 3. There are four different levels of information involving the Naval Station Branch Clinic. The first level of information exists between the administrative division of the clinic and two higher levels of administrative authority, Naval Medical Command, Southwest Region, headquartered in San Diego, and Naval Medical Command (MEDCOM), headquartered in Washington, DC. Requests for informa-

tion originating from the Southwest Region or MEDCOM are usually presented in the form of instructions. These instructions dictate the reporting requirements of the branch clinic. The two major reporting requirements involve the Uniform Statistical Methodology (USM) and the Uniform Chart of Accounts (UCA). The USM requires the clinic to record on a daily basis the actual number of hours worked by clinic personnel. These hours are tabulated by type of staff (officer, enlisted, civilian, and volunteer) and by functional category (clinician, direct care professional, registered nurse, direct care paraprofessional, and administrative/clerical/logistic/other). These reports are submitted on a quarterly basis. The UCA includes a monthly medical services and morbidity report which is based on a log of each patient seen in the clinic. The UCA also provides workload data and contains much of the same information as the USM. Both reports are the responsibility of a clinic coordinator who submits them on a quarterly basis. In addition, there exist numerous instructions for reports on a wide variety of topics such as quality control, commercial activities, and productivity trends. These reports are submitted on a monthly, quarterly, or yearly basis depending on the instruction, and for the most part, utilize the same information.

The second level of information flows in one direction from the branches in the Ancillary and Clinical Divisions to the Administrative Division. This information is used both to generate the reports which are sent to MEDCOM and the Southwest Region and to make administrative decisions regarding staffing assignments, supply allocations, logistical support, and quality control.

The third level of information involves a two-way communication between the branches in the Clinical Division and the branches in the Ancillary Division. This interaction usually originates as a request for information to the ancillary branches from the clinical branches and is followed by a response from the ancillary branches. These requests involve the performance of lab tests and x-rays or the filling out of prescriptions by the pharmacy. Responses are in the form of lab and x-ray results and data on medications taken and prescriptions filled. A similar type of information exchange occurs between the fiscal/supply branch of the Administrative Division and the Naval Medical Annex at the Naval Supply Center. Requests are generated by the fiscal/supply branch.

The fourth level of information involves two-way communications between branches within a division. Much of this information flow occurs within the Clinical Division where information on patients seen in one branch may be requested by another branch. This level of information exchange usually involves the primary care branch where the patient is first seen and the branch to which the patient is referred if further examination or treatment is considered to be appropriate. This level of information flow is also found to occur among the branches in the Administrative Division but occurs only infrequently among the branches of the Ancillary Division.

The information required for each level of communication originates with the entry of the patient into the clinic. Typically, the patient enters the treatment and information system by reporting for sick call (primary care). Preliminary demographic information and information regarding the nature of the complaint is recorded on a patient encounter form which becomes part of the patient's medical record. The patient is then evaluated by a general medical officer (GMO) who is assigned to sick call. An evaluation is made by the GMO and recorded in the patient's

medical file. If it is considered appropriate, the patient may then be sent to a branch of the Ancillary Division for lab tests, x-rays and/or medications, or he may be sent to one of the other branches in the Clinical Division. Patients may also be seen by these other clinical branches as referrals from shipboard or other shore-based clinics or for follow-up visits without first having to report to sick call. A log of patients seen is kept by each branch in the Clinical and Ancillary Divisions. The information in the third and fourth levels of communication is primarily used for clinical purposes while the information in the first and second levels is used for administrative purposes.

INFORMATION SYSTEM DESIGN

In designing a medical information system which can be utilized by CONUS and remote clinics, several factors should be kept in mind. One such consideration is the level of specificity of information required by each clinic. For instance, a general medical officer at a remote overseas clinic may not require as much information on a patient reporting for sick call as a specialist at a CONUS clinic in San Diego. Data needs of each level of patient care should be identified.

A second consideration is the fact that the same type of information may be required for different purposes. The design of a comprehensive medical information system which may be utilized by all types of outpatient clinics for clinical, administrative, and research purpose will require that those data elements which are common and those which are unique to each of these functions be identified.

A third consideration is the necessity for the establishment of designated points of entry into a medical information system. In a CONUS outpatient clinic such as the Naval Station Branch Clinic, San Diego, patients may enter the system in several different ways such as sick call, referrals to specialized branches from other clinics, dispensaries and commands, or as follow-up visits.

The experience from existing medical information systems in outpatient settings can provide some guidelines in the design and implementation of a comprehensive system for use in CONUS and remote shorebased clinics. The Navy Mental Health Information System (NAMHIS) is nearly ready for operation at the Mental Health Unit, Naval Station, San Diego. Extensive background evaluation was necessary to determine the specific information and recordkeeping needs of clinicians and the organization. Visits were made to area clinics to identify standard operating procedures (SOPs) and reporting requirements. An analysis of patient referral patterns and demographics helped define the parameters of data collection. The content of clinical reports and of existing data collection forms was reviewed to further determine the specificity of information needed. Based on these findings, a system was tailored in both content and format to meeting the needs of a Navy outpatient mental health unit.

Similarly, initial work on the Navy Occupational Health Information Management System (NOHIMS)[4] involved a comprehensive systems analysis of recordkeeping and reporting requirements at an industrial facility clinic. Specifications for collecting, processing, and displaying medical and environmental data were developed. The types of data needed had to be determined and reference tables compiled so that these data could be placed in a meaningful context. Reports

were developed and the logical receivers identified. Such preliminary work was crucial to the development of an information system that could coordinate the components of the Navy's occupational health program.

SUMMARY

A comprehensive systems analysis of Navy branch clinics revealed findings important to the design and implementation of an automated medical information system. The organizational structure and information requirements of the clinics and their relationship to the Navy Medical Command define the parameters of the system. Within the branch clinics, it was necessary to identify the levels of communication and the flow of information. This was a prerequisite to the design of a system which would allow different organizational branches to extract medical information required to meet specific reporting objectives. A review of existing automated information systems tailored to specific Navy needs had been undertaken. Their applicability to a branch clinic setting and their implications with regards to the OMIS have yet to be determined.

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FIGURE 1

ORGANIZATION, NAVAL MEDICAL CLINIC, SAN DIEGO

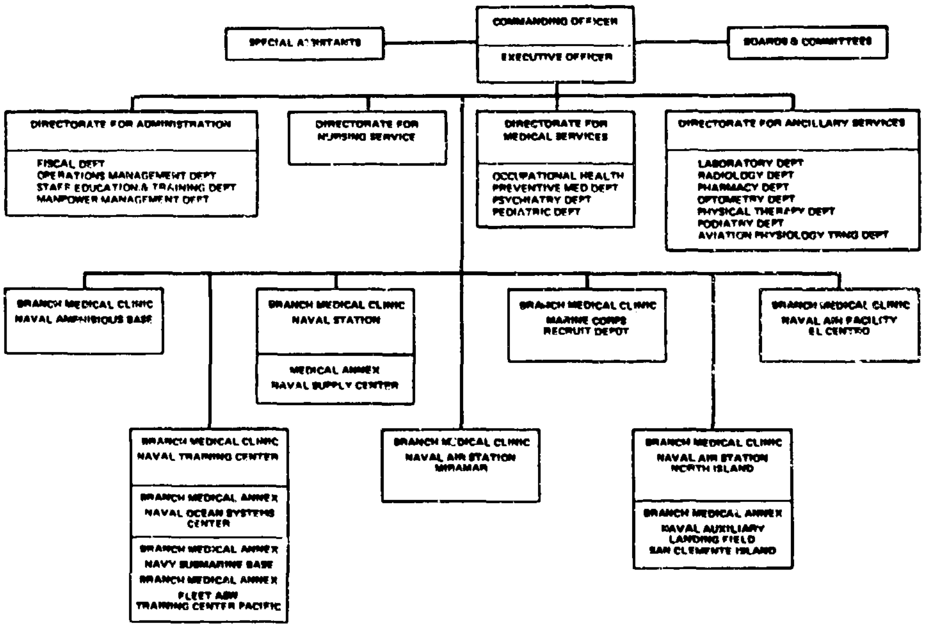


FIGURE 2

ORGANIZATION, BRANCH MEDICAL CLINIC, NAVAL STATION SAN DIEGO

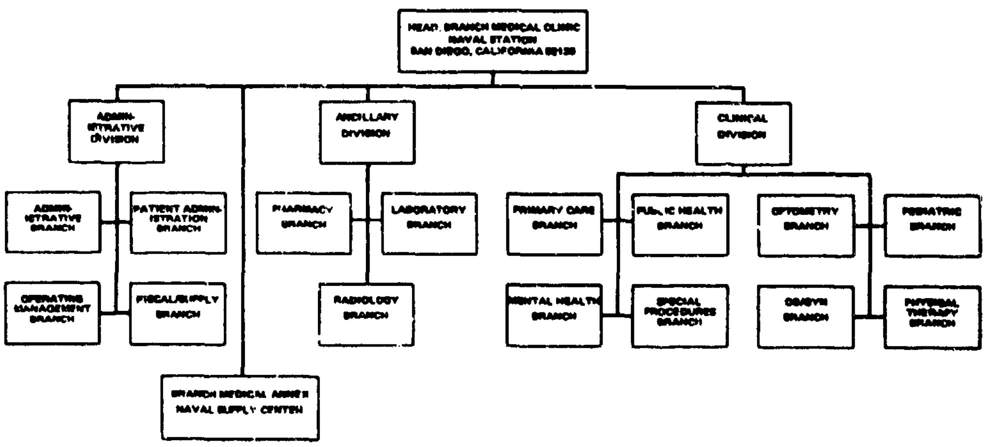
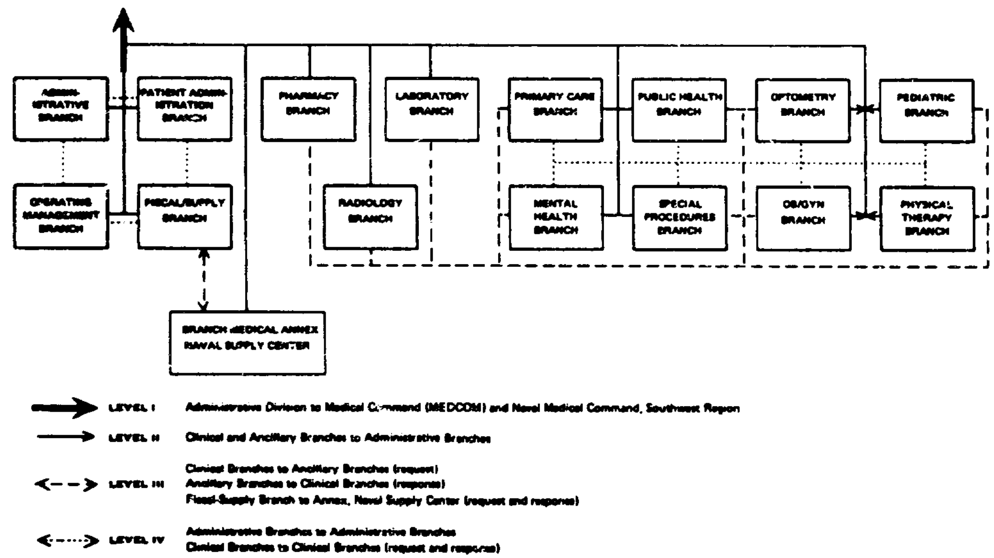


FIGURE 3

LEVELS OF INFORMATION FLOW
BRANCH MEDICAL CLINIC, NAVAL STATION SAN DIEGO



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Medical reporting requirements
Ambulatory medical care

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

As part of the OMIS development, a systems analysis is being conducted to determine the organizational structure and reporting requirements of Navy branch clinics, the services provided, and the data elements required by each service. Results of the systems analysis will be used to develop a system design. Existing medical information systems offer guidelines for further development.

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SELECTION OF A FIELD SEVERITY SCORING SYSTEM FOR THE NAVY
OPERATIONAL MEDICAL INFORMATION SYSTEM

Frank C. Garland, Ph.D.

Abstract

Injury severity scoring techniques can greatly aid case management and allow for evaluation of the effectiveness of medical care. This paper characterizes the needs of OMIS and assesses the scoring systems currently available. The Triage Index, a simplified severity scoring system requiring no medical equipment, appears to best meet the specialized OMIS needs of rapid care in urgent field settings.

INTRODUCTION

Advanced emergency-care systems include severity scoring techniques to help in case management and evaluation of the effectiveness of care. A decision must be made concerning which of several severity systems in the medical literature is best suited for use as part of the Operational Medical Information System (OMIS).

A good decision requires characterizing the needs of OMIS, assessing the scoring systems available, and determining the degree of match between the needs and capabilities. It also involves assessment of whether existing scoring systems are suitable, or whether a scoring system should be especially designed for use in OMIS.

OMIS NEEDS

A workshop on the Fleet Marine Force Medical Information System in San Diego during April, 1984, examined whether an injury severity scoring system should be adopted and concluded that such a system would be desirable(1). The participants in this conference felt that a severity scoring system would be an aid to decision-making in critical trauma care, especially if screening in the field is performed by persons with only limited training, and that severity scoring could be accomplished in a manner that does not interfere with medical or other operations.

Modern systems for emergency care require simple, rapid-to-use techniques for assessing the severity of injuries of illnesses, expediting care to those with the most urgent needs, and selecting the echelon of care to which the patient should be transported. (Direct aeromedical transportation to higher echelons providing extensive care for severe cases may be possible under certain conditions.)

Physicians and trained nurses are not generally available to provide severity assessments at the scene of injury or sudden illness, either in civilian or military settings. Therefore, assessment techniques which do not require extensive medical training or experience are needed.

The techniques must be simple, quick to administer, and easy to learn. They must be able to correctly identify patients in immediate need of care. They should apply to a wide range of conditions--from trauma to burns to acute mental impairments.

It would be highly desirable if they could also be used for practical evaluation of the benefits of emergency medical care, including rapid transportation, on-scene treatment, and medical care at each echelon. This requires techniques which can be readily computerized.

CRITERIA FOR A SEVERITY SCORING SYSTEM FOR FIELD USE

Criteria have been developed by Gibson[2] and Krischer[3] for evaluating injury severity scoring systems. The criteria used by Gibson specify that the scoring systems should yield the same score for different users (reliability), yield a score that accurately reflects severity (validity), responds to the needs of the system for data, and applies to a wide variety of types of illnesses and settings (generalizability). It should also be constructed, if possible, using only simple, consistent arithmetic.

Existing criteria were insufficient for judging OMIS needs, both because they were not adequately specific and because they did not concern the practicality of administering the system in the field under demanding conditions, or because of the requirements for personnel resources and training. Forrey has delineated the analogies and differences between civilian and military trauma care and described systems for each[4].

Criteria for a trauma severity scoring system in OMIS should reflect the specialized needs of urgent field settings. There are several criteria which a severity scoring system for field use in OMIS should meet. In particular, the system should be:

- Sensitive -- it should correctly identify patients urgently needing medical care.
- Specific -- it should correctly identify patients not urgently needing care.
- Quick to use -- it should take, on the average, no more than one minute to obtain and should never take more than 90 seconds, even in difficult cases.
- Suitable for use by any high school graduate after minimal training (e.g., < 10 hours)
- And, if possible, it should require no equipment.

EXISTING SCORES

The value of scores to assess the severity of injuries was recognized during the 1970s, when Kirkpatrick and Youmans[5] published a trauma index based on nature of injury and anatomical site, plus assessemnt of cardiovascular, respiratory, and central nervous system status. This score required considerable training and clinical judgment to use, and it was, therefore, not usable for routine severity screening in the field. It was, however, a pioneering effort that inspired further thinking and developments. The need for a scientific approach to the question of severity of injury stimulated Baker and Associates[6] to develop an injury severity score.

The severity score developed by Baker et al. reflected an unmet need for evaluation of the efficacy of emergency treatment. It is designed to be applied during scientific analysis of the results of care and is not intended for field screening of injuries.

Current injury and illness severity scoring systems can be divided into three tracks, i.e., systems primarily oriented toward:

- Field emergency care, or
- Hospital intensive care, or
- Analysis of quality of care

The first two tracks are operational, intended for minute-to-minute use during patient care; the third is for longer-term analysis and evaluation studies. The first two tracks can be used to assist in evaluating quality of care, but long-term analytic scores are generally calculated after treatment has been completed and are not useful in decision-making during emergency care. While both operational and analytic objectives are worthwhile, it is likely that only a score which has an operational benefit will be accepted and widely used in emergency medicine[1].

Fortunately, severity scores have been developed which will serve both emergency management and analytic objectives. Further discussion concerns only severity scoring systems that are useful for field emergency care. These scoring systems are summarized in Table 1.

Table 1

Severity Scoring Systems for Field Use

System	Time required (mins) (estimated)	Training required	Equipment required	Validity (in civilian setting) Sensitivity	Specificity
Trauma Score[8]	3-5	EMT-II	Yes	83%	99%
Triage Index[9]	≤ 1	EMT-I	No	96%	88%
CRAMS Scale[10]	3-5	EMT-II	Yes	92%	98%
Kirkpatrick-Youmans Index[4]	5+	MD	Yes	-	-

Among severity scoring systems, the principal candidates for OMIS use are the (1) Champion-Sacco Trauma Score, (2) CRAMS Scale, and (3) Triage Index. The Trauma Score involves the seven elements shown in Table 2. The scale may take three minutes or longer to obtain, since blood pressure must be measured using a sphygmomanometer. The Trauma Score can be administered by an emergency-medical-technician-level worker who has had training taking blood pressure. This score appears to have marginally good sensitivity (83%) with high specificity (99%)[7]. It has been applied successfully both to blunt[8] and penetrating trauma[7].

Table 2

Elements of the Champion-Sacco Trauma Score

- Respiratory Rate (5 Categories)
- Respiratory Effort (2 Categories)
- Systolic Blood Pressure (5 Categories)
- Capillary Refill (3 Categories)
- Eye Opening (Glasgow) (4 Categories)
- Verbal Response (Glasgow) (5 Categories)
- Motor Response (Glasgow) (6 Categories)

Source: Sacco WJ, Champion HR, Gainer PS, et al. 1984.

The Champion-Sacco Trauma Score has the disadvantage that it requires a systolic blood pressure measurement. While this is not a complicated procedure, it takes time (3-5 minutes) that may be valuable in critical situations and requires equipment that may not be available or always operating.

An alternative is the Triage Index[9]. This index deletes the blood pressure measurement, reducing the time required to less than one minute, and avoids the need for any equipment. It has

moderately good sensitivity (96%) and moderately good specificity (88%). High sensitivity is desirable, since patients who are incorrectly identified as noncritical may die if not given rapid attention. High specificity is desirable in order to avoid system overload but ranks somewhat lower in value than high sensitivity. Hospital corpsmen could be taught to use the Triage Index with only brief training.

The CRAMS scale is similar to and modified from the trauma score, and has the same advantages. Gormican(10) has reported higher sensitivity for the CRAMS scale than for the Champion-Sacco Trauma Score, but considerably more study would be needed to adequately test this comparison.

The Kirkpatrick-Youmans(5) Trauma Index is intended for use by personnel with extensive clinical experience and training and requires equipment and a relatively long time to obtain.

CONCLUSIONS

The Triage Index(9) best meets OMIS needs, although its sensitivity and specificity are far less than optimal. The Triage Index is simple and quick to use, requires no equipment, and can be learned by hospital corpsmen.

An improvement in the sensitivity/specificity of this scale would reduce the overload on higher-echelon treatment centers, improving system effectiveness overall, and attention should be devoted to this objective.

The other indices evaluated would take excessively long to administer in the field during critical situations and do not yield gains in sensitivity. They should, therefore, not be adopted.

Use of the Triage Index should become a routine part of emergency medical care in OMIS. Such use would be facilitated by a field assessemnt card in graphic format (Figure 1) that is easy to complete and highly visible during transportation and medical care.

Use of the Triage Index will contribute much to expediting emergency medical care to patients urgently in need while preventing overloads that could impair quality treatment and will provide a sound basis for research in the Navy to continually improve the quality of emergency medical care.

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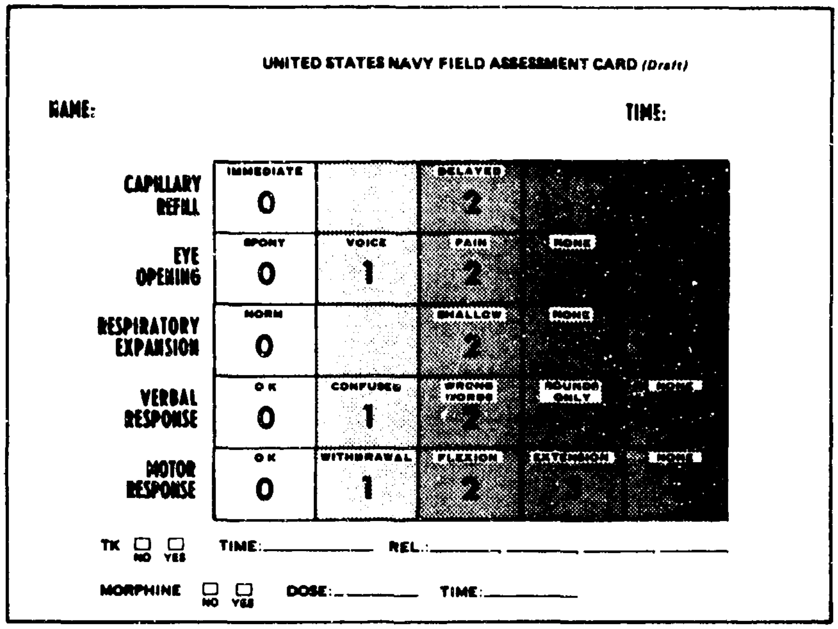

UNITED STATES NAVY FIELD ASSESSMENT CARD *(Draft)*

NAME: TIME:

CAPILLARY REFILL	IMMEDIATE 0		DELAYED 2		
EYE OPENING	SPONT 0	VOICE 1	PAIN 2	NONE	
RESPIRATORY EXPANSION	NORM 0		SHALLOW 2	NONE	
VERBAL RESPONSE	O K 0	CONFUSED 1	WRONG WORDS 2	SOUNDS ONLY	NONE
MOTOR RESPONSE	O K 0	WITHDRAWAL 1	FLEXION 2	EXTENSION	NONE

TK ☐ NO ☐ YES TIME:__________ REL.:________ ________ ________ ________

MORPHINE ☐ NO ☐ YES DOSE:________ TIME:________

FIGURE 1

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